RESPONSE AND REQUEST FOR RECONSIDERATION

Response.

The present invention relates to a low sulfur, low phosphorus lubricant formulation for internal combustion engines. It permits the use of reduced amounts of zinc dialkyldithiophosphate (ZDDP) in the lubricant, while still providing good antiwear performance. It does this by using a nitrogen-free sulfurized olefin antiwear agent.

The examiner has rejected all claims as made obvious by Fetterman '566 in view of Davis '618 and, as to claim 11, further in view of Schenck '985.

Fetterman differs from the present claims in several respects. Fetterman, first, teaches the use of certain oil soluble sulfurized organic compounds as *antioxidants* (col. 30 lines 45-46 and col. 32 line 54), although he does not use them as anti-wear agents. Rather, Fetterman requires a dihydrocarbyl dithiophosphate, e.g., "ZDDP," as his anti-wear agent – col. 37, lines 45-46. Likewise, in Fetterman's examples, there is no use of a nitrogen-free sulfurized olefin antiwear agent; the closest component to this would be a sulfurized alkyl phenol which is employed as an antioxidant. It is evident that the sulfurized alkyl phenol antioxidant employed in Fetterman's examples is chemically different from a sulfurized olefin, a difference that goes beyond a mere label of antioxidant or antiwear agent.

Fetterman, moreover, does not specify a limit on phosphorus for his compositions. The test formulations in Table 1 of Fetterman, as described in footnote 3, contain 1.45 volume % ZDDP having a phosphorus level of about 7 wt.% and 0.30 vol.% ZDDP having a phosphorus level of about 8 wt.% (for Comparative A), or 1.45 vol. % ZDDP having a phosphorus level of about 7 wt.% (for Comparative B and for Ex. 1). The phosphorus content for Ex. 2 is not reported, but the volume % of ZDP is reported in the table as 1.35%, which is the same value as entered therein for Ex. 1. It is understood that these amounts would correspond to a phosphorus level of greater than 0.1 percent. (See the accompanying Declaration from Virginia Carrick, footnote b to Table.)

The sulfated ash limit specified by Fetterman also differs from that of the present invention. Fetterman specifies 0.01 to about 0.6 wt % ash; the actual sulfated ash in Examples 1 and 2 is 0.44 and 0.5%, respectively. The present preference for a higher (but still limited) amount of sulfated ash is because the metal-based detergents which supply ash promote engine cleanliness and neutralize acidic combustion products that find their way into the lubricating composition; therefore, a certain (but not excessive) amount is desirable.

The Examiner indicated that the lack of clear teaching in Fetterman relating to phosphorus level was apparently the only difference from the present invention, but that

lack was remedied by **Davis**, which teaches a low phosphorus (less than 0.1%), low sulfur lubricating oil.

Applicants respectfully submit that the differences of the present invention, compared with the teachings of Fetterman, alone or combined with Davis, are sufficiently great that there is not even a case of *prima facie* obviousness. There is no motivation for Fetterman to use a low amount ZDDP (that is, a low amount of phosphorus source) in a higher ash formulation, nor for using a sulfurized olefin for its antiwear properties, whether as a variant of his sulfur-containing antioxidant or in place of part of the ZDDP.

Moreover, any *prima facie* case of obviousness that might be made out is overcome by the experimental evidence supplied in the attached Declaration from Ms. Virginia Carrick. Ms. Carrick has compared the present invention with the closest teaching in Fetterman, which is believed to be the composition of Example 1, column 52. Relevant portions of Ms. Carrick's Table are summarized below:

Example:	F Ex 1'	Ref A	Ex B	F Ex 1	Ref C	Ex D
	lower phosphorus series			higher phosphorus series		
	lower P variant of Fetterman	same, increased ash	present invention (cl. 18)	Fetterman's Example 1	same, increased ash	present invention
S'd phenol antioxidant	+	+		+	+	
S'd olefin antiwear			+			+
% Ash	0.45	0.80	0.82	0.52	0.88	0.88
% P	0.075	0.076	0.080	0.096	0.096	0.099
HFRR wear scar	255	323	**206**	**236**	259	242

Ms. Carrick's Declaration presents a direct comparison between a close reproduction of Example 1 of Fetterman[1] (F Ex 1) and the same material but modified by increasing the sulfated ash to a value within the present claims and by replacing the sulfurized alkylphenol antioxidant with a sulfurized olefin (Ex. D). The values for wear scar and friction coefficient in the HFRR test are virtually unchanged, which is, however, quite an unexpectedly beneficial result. Apart from the benefits of having a somewhat higher level of detergent-derived sulfated ash (engine cleanliness and acid

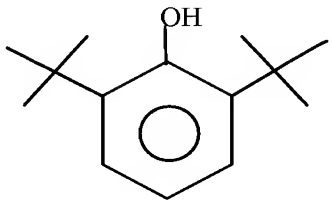
[1] -- although it is believed that Fetterman's example 1 actually had a somewhat higher level of P.

neutralization), increasing the ash level is known to adversely affect wear performance. This is clearly illustrated by comparing Ref C with F Ex 1. Ref C is the same as F Ex 1, but merely with a higher ash level, and the wear performance is significantly worsened. (The same trend is observed by comparing Ref A with F Ex 1'.) However, when the sulfurized olefin is included in Ex D, good wear performance is once again attained.

The improvements of the present invention may be seen even more plainly in formulations having further reduced phosphorus content (that is, reduced ZDDP content). Ex B contains only 0.08 percent phosphorus, within the limits of new claim 18. While reduced phosphorus and increased ash would both lead to worse wear performance, Ref B actually has significantly improved wear performance compared with Fetterman's example 1 (F Ex 1).

Accordingly, any *prima facie* obviousness of the present claims is overcome by these unexpectedly improved results.

The same evidence for unobviousness applies equally to claim 11, for which the Examiner had further cited **Schenck**. Claim 11 specifies that the antioxidant comprises a hindered ester-substituted phenol antioxidant. Considering the disclosure of Schenck in greater detail, however, it is immediately evident that the aromatic phosphate esters in Schenck are not phenolic antioxidants at all. The feature of hindered phenolic antioxidants that is widely known to provide basic antioxidant performance is the presence of a hindered phenolic OH group, such as in



The esterification of the phenolic OH by Schenck would remove the antioxidant nature of any of these compounds, so that the skilled person, desiring an antioxidant for the formulations of the present invention, would not look to Schenck to meet this need. The desired nature of the presently-specified ester-substituted hindered phenol compounds is set forth in paragraph 0062, and this type of structure is now specified in new claim 20. Antioxidants of this type are known (see, e.g., U.S. patent 6,559,105 = US publication 2002-0006878), but neither they nor their use in the present lubricant formulations are disclosed or made obvious by the teachings of Schenck '985.

Conclusion.

For the foregoing reasons it is submitted that the present claims are unobvious and in condition for allowance. The foregoing remarks are believed to be a full and complete response to the outstanding office action. Therefore an early and favorable reconsideration is respectfully requested. If the Examiner believes that only minor issues remain to be resolved, a telephone call to the Undersigned is suggested.

The total number of claims is now 20, and no new independent claims have been submitted. Accordingly, it is believed that no additional fees are due. However, any required fees or any deficiency or overpayment in fees should be charged or credited to deposit account 12-2275 (The Lubrizol Corporation).

Respectfully submitted,

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